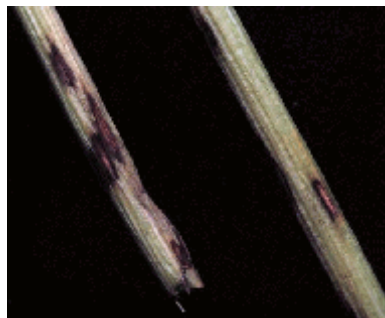


CARROTS FOR MICHIGAN'S FUTURE

Developing Expanded Markets and New Pest Management Approaches

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I. Abstract: The carrot industry in Michigan is at a critical juncture for two reasons. The sale of salvage carrots as deer bait was reduced by 50% as a result of baiting restrictions adopted by the Natural Resources Commission in an effort to eliminate tuberculosis from the wildlife herd, and products currently relied upon for pest management in carrot production face an uncertain future as a result of the Food Quality Protection Act and processor restrictions. Objectives of this research are to: 1) expand and/or develop additional markets for Michigan carrots, and 2) develop a pest management transition strategy. Research supporting objective 1 is ongoing. Data on marketing is being entered into a statistical program for analysis. An extensive literature review of carrot markets/marketing is in progress, including fresh products, food marketing and consumer behavior regarding traditional and organically grown produce. Quantities of six cultivars of carrots were grown organically to be used this fall by two focus groups for research into consumer attitudes regarding carrot consumption. Pesticide trials at MSU facilities and in grower cooperators' fields this summer investigated objective 2. A new sprayer was built with a patented applicator (Proptec) to apply chemicals with a very low volume/A; this sprayer was used in two research plots for application of fungicides and herbicides. The Proptec applicator enhanced the efficacy of Kocide (copper) compared with Quadris (azoxystrobin) and with the grower's conventional spray program. It was also effective in applying herbicides while preventing crop phytotoxicity. Nine trials were established in cooperators' fields testing the efficacy of herbicides, fungicides, and a disease forecaster (Tom-Cast) versus calendar-based fungicide spray programs. Maxim (fludioxonil, a reduced risk fungicide) and Bravo Ultrex (chlorothalonil) significantly decreased foliar fungal diseases of carrot as measured by foliar rating and severity of stem infection. Tom-Cast was effective in foliar disease control, and reduced the number of fungicide applications compared to a calendar-based spray program. A cultivar trial was established to screen varieties for resistance to carrot diseases. Certain carrot cultivars proved to be more attractive to aster leafhoppers; these results will be compared with severity of aster yellows symptoms to determine overall resistance of different varieties to this disease. Carrot cultivars are being harvested and evaluated for resistance to foliar fungal diseases. Results of this GREEN-funded research will be used to ensure the economic stability and prompt future growth of the Michigan carrot industry through the development of new and expanded markets, value-added products and novel pest management and production systems that minimize pesticide use and utilize reduced risk pesticides.



Fungal lesions on carrot petioles.
Severe disease prevents harvest.



Proptec sprayer built for carrots.

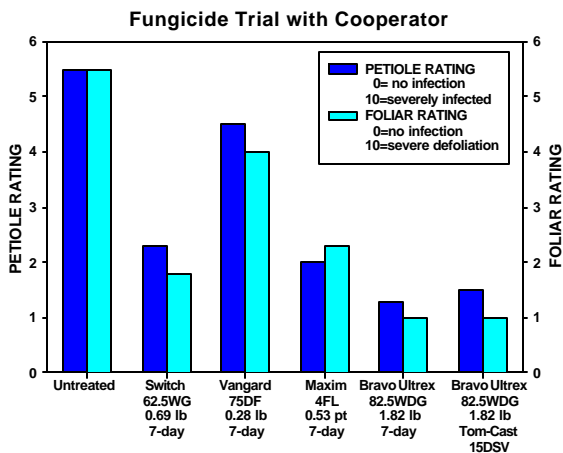


Growers gather to hear about new technology in carrot pest management.

II. Objectives: 1) Expand and/or develop additional markets for Michigan carrots:

a) Assess current markets. b) Develop alternative uses and value-added products. **2) Develop a pest management transition strategy:** a) Test alternatives for currently registered pesticides at risk with emphasis on reduced risk products or “soft” pesticides. b) Develop forecasting and pest monitoring systems to time sprays. c) Use precision application and technology to decrease amount of active ingredient and/or increase application interval. d) Screen varieties for pest resistance.

III. Results: 1a) To determine the impact of imported carrots on the Michigan carrot market, data (including point of entry, value, pounds) has been entered into and will be evaluated by a statistical program. An extensive literature review of carrot markets and marketing is in progress, including information on fresh products, food marketing, and consumer behavior relative to traditional and organic produce. **1b)** Four mid-Michigan organic farmers were subcontracted to produce 25 to 30 lb



of six cultivars of carrots to be used for consumer research. Two focus groups (one of adults and one of children, 10 to 12 persons per group) will be conducted by MOREPACE, Intl. in October using these organic carrots to research fresh carrot consumption. Attitudes investigated will include perceived benefits of carrots, current carrot consumption, barriers to additional consumption, “traditional” versus “organic” carrots, importance and relevance of Michigan-grown carrots to Michigan consumers, carrot taste and safety, and carrot juice and extract as food product additives.

2a,b) Four trials were established in cooperators’ fields comparing the effects of fungicides, and timing of sprays by calendar versus Tom-Cast disease forecaster on the occurrence of foliar carrot diseases. Maxim (fludioxonil, a reduced risk fungicide) and Bravo Ultrex (chlorothalonil) significantly decreased disease as measured by foliar rating and severity of stem infection. Four trials were established (three on cooperator’s fields, one at the MSU Muck Farm) to test new herbicides on carrot production. No preemergence herbicide tested on carrots was as effective as linuron, the standard; flumioxazin (0.01 lb ai/A) caused severe stand reduction in carrots grown in sand. Flumioxazin (0.025 lb ai/A), oxyfluorfen, azafenidin, sulfentrazone and flumiclorac gave good postemergence weed control with crop safety.



The Proptec sprayer enhanced disease control with Kocide (copper)

Fungicide Trial with Cooperator Using New Spray Technology					
Treatment and rate/A, application schedule (applied with Proptec sprayer, grower used conventional sprayer)	Severity of stem infection ¹		Foliar rating ²		Yield per 10' row (lb)
Untreated	4.5	b ³	3.8	b	20.6
Kocide 2000 53.8DF 1.5 lb, 7 day . . .	1.3	a	1.8	a	20.5
Kocide 2000 53.8DF 1.5 lb, 7 day + Quadris 2.08SC 0.58 pt, 14-day intervals (at 10% disease incidence) . .	1.3	a	1.0	a	20.5
Treated as needed by grower	1.0	a	1.8	a	21.3

¹Rated on a scale of 0 to 10, where 0=no infection to 10=severely infected.

²Rated on a scale of 0 to 10, where 0=no infection to 10=severe defoliation.

³Column means with a letter in common are not significantly different (Student-

Linuron selectively controlled nutsedge initially, but the weeds regrew. **2c)** A new sprayer was built with a patented applicator (Proptec) to apply chemicals at a very low volume/A. The Proptec spray head uses air as the primary carrier and breaks the liquid into small uniform droplets for better coverage on all leaf surfaces. It was tested in a research plot at a cooperator's farm

for disease control and at the MSU Muck Farm for control of yellow nutsedge. Treatments in the foliar blight trial all significantly decreased disease compared to the untreated control. The Proptec sprayer gave no advantage over a conventional sprayer in postemergence herbicide applications of linuron; however, carrots were not affected adversely. **2d)** A cultivar trial to screen for disease resistance was established in a cooperator's field. It will be harvested and evaluated in October. The number of aster leafhoppers in different carrot cultivars was determined by regularly taking sweep samples in several commercial fields and a 26-variety trial in Oceana Co., MI. Aster leafhoppers showed distinct preferences for certain carrot varieties. Results will be compared with severity of aster yellows symptoms to determine overall resistance of carrot varieties.

IV. Discussion: Several challenges face the carrot industry in Michigan. Research conducted within the first six months of this project has been vigorous. Marketing research, including composting carrot culls as an alternative to cull disposal, will be pursued this winter and spring. Weed control experiments for crop safety will be conducted in the greenhouse over the winter. **Accomplishments:**

- Retention of processors wishing to receive produce with reduced fungicides.
- New spray technology allows use of copper alone to control foliar blights.
- EPA personnel saw Michigan growers' commitment to advancing pest management alternatives, disease forecaster use, and technologies.
- The Proptec was designed for spraying carrots and was used in herbicide and fungicide trials.
- The Proptec, built by funds from this project, was used in crops other than carrots, including potatoes, Christmas trees, asparagus, and ornamentals.
- The Tom-Cast disease forecaster was compared to a calendar-based spray program and found to be effective even though the number of fungicide applications was reduced.
- In a controlled study, the Proptec sprayer enhanced the efficacy of Kocide (copper) compared with Quadris (azoxystrobin) and with the grower's conventional fungicide program.
- The Proptec was an effective tool in applying herbicides without resulting in phytotoxicity.

V. Impacts: Research will be used to develop new markets, value-added products, and novel pest

management and production systems that will ensure economic stability and prompt future growth of the Michigan carrot industry. The result will be new markets for high quality carrots (few culls) and a pest management strategy that minimizes pesticide use and utilizes reduced risk pesticides.

Extension activities:

The Proptec sprayer was demonstrated at the following field meetings: 1) Oceana Summer Field Day, 2) MSU Muck Farm Field Day, 3) EPA Field Tour, and 4) Asparagus Sprayer Demonstration Meeting.

“Pest management in the future, a strategic plan for the Michigan carrot industry,” Michigan State University, E. Lansing, MI.

“Identification of carrot diseases,” “Carrot fungicide evaluation and Tom-Cast,” Great Lakes Vegetable Convention, Grand Rapids, MI.

Anticipated end date of the project: 2½ years.

Funding partnerships: USDA (A Partnership Among US Carrot Stakeholders to Develop and Implement IPM), \$1,253,938/3 years; Michigan Carrot Committee: \$4,500; fungicide companies: \$1,400.